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THE TUBERCULIN TEST OF CATTLE FOR TUBERCULOSIS.

BY

JOHN R. MOHLER, A. M., V. M. D.,
*Chief of the Pathological Division, Bureau of
Animal Industry.*



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U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., December 30, 1908.

SIR: I have the honor to transmit herewith a paper on The Tuberculin Test of Cattle for Tuberculosis, by Dr. John R. Mohler, Chief of the Pathological Division of this Bureau.

Tuberculosis of cattle, although not so prevalent in the United States as in some other countries, nevertheless exists here to an alarming extent, especially in some States where no steps have been taken for its suppression. It is estimated that on an average not less than 1 per cent of the beef cattle and 10 per cent of the dairy cattle in the country are affected with this disease, and in some localities the percentages are very much higher. The financial loss from tuberculosis in live stock is not less than \$14,000,000 annually.

As the first step in any measure for eradication, either by public authorities or by private owners, it is necessary that there should be some accurate and reliable method of diagnosis. In the great majority of cases it is impossible to detect the disease in the living animal by ordinary physical examination. The tuberculin test, as pointed out by Doctor Mohler, affords the most reliable known method for detecting tuberculosis in cattle, records having proved its accuracy in over 97 per cent of cases, and it has the additional advantage of being harmless.

It is important, however, that a reliable tuberculin be used, as experiments by this Bureau have shown that some of the tuberculin on the market is impotent and worthless. It seems likely that some of the dissatisfaction occasionally experienced with the tuberculin test is due to this fact. The Bureau of Animal Industry prepares a trustworthy tuberculin and furnishes it free of charge to health officers and other public authorities under certain conditions for official use. The Bureau can not, however, supply tuberculin on any terms for private use.

The accompanying paper was included in the Twenty-fourth Annual Report of this Bureau, but in order to make it available for wide distribution in pamphlet form I respectfully recommend its publication also in the Farmers' Bulletin series.

Respectfully,

A. D. MELVIN,
Chief of Bureau.

HON. JAMES WILSON,
Secretary of Agriculture.

THE TUBERCULIN TEST OF CATTLE FOR TUBERCULOSIS.

THE DIAGNOSIS OF TUBERCULOSIS.

The symptoms of tuberculosis in cattle are not sufficiently prominent, except in advanced stages or when superficially located, to enable one to diagnose this disease by the ordinary methods of physical examination. And the cattle may, without showing any clinical symptoms, be in such a stage of tuberculosis as to render them capable of spreading disease. Indeed, an animal may be fat and sleek, eat and milk well, have a bright, glossy coat, and be apparently in the pink of condition, and still be passing tubercle bacilli through the feces or by an occasional cough, and thus endanger all the healthy cattle in the herd. Consequently such adventitious aids to diagnosis as animal inoculation, biological test, serum agglutination reaction, and the tuberculin test are made use of in arriving at a definite opinion relative to the presence or absence of this disease. The value of all but the last of these is discounted by the technique required and by their impracticability, while the tuberculin test is most satisfactory and is the best diagnostic agent known for the disease.

THE ORIGIN OF THE TUBERCULIN TEST.

Tuberculin was invented by Koch in 1890, and was first used experimentally in treating tuberculosis in man. In these cases it was observed that its injection was followed by a rise of temperature, which led veterinarians to apply tuberculin to suspected animals to see if a similar reaction resulted. Numerous experiments showed this to be the case, and since 1891 the use of tuberculin as a diagnostic agent for tuberculosis of cattle has been almost universally adopted in all parts of the civilized world. No one thinks of accepting tuberculin as an absolutely infallible agent, but it is immeasurably more dependable than any other method that has ever been used.

THE NATURE AND APPLICATION OF TUBERCULIN.

Tuberculin is the sterilized and filtered glycerin extract of cultures of tubercle bacilli. It contains the cooked products of the growth of these bacilli, but not the bacilli themselves. Consequently, when this substance is injected under the skin of an animal it is absolutely

unable to produce the disease, cause abortion, or otherwise injure the animal. In case the injected animal is normal there is no more effect upon the system than would be expected from the injection of sterile water. However, if the animal is tuberculous, a decided rise of temperature will follow the use of tuberculin.

In practice the tuberculin test is applied by first taking a sufficient number of temperatures, usually three, at intervals of two hours to ascertain the normal variation of temperature of the animal to be tested. The dose of tuberculin (which should always be specified on the label) is then injected hypodermically between 8 and 10 p. m. on the day of taking the preliminary temperatures.^a On the following day the "after" temperatures are recorded every two hours, beginning at 6 a. m. and continuing until twenty hours following the injection.

THE VALUE AND RELIABILITY OF THE TUBERCULIN TEST.

As a result of this method an accurate diagnosis may be established in over 97 per cent of the cases tested.^b The relatively few failures in diagnosis are included among two classes of cattle. The first class contains those that are tuberculous but which do not react either because of the slight effect of an ordinary-sized dose of tuberculin on an advanced case of the disease with so much natural tuberculin already in the system, or on account of a previous test with tuberculin which produces a tolerance to this material lasting for about six weeks. The second class includes those that are not tuberculous but

^a Great interest has been manifested recently in the cuti tuberculin test of Von Pirquet and the ophthalmic tuberculin test of Wolff-Eisner and Calmette. As their names imply, these tests consist in the application of the tuberculin to the eye and to the scarified skin, respectively, of the animal to be tested. The very favorable results which were reported from the application of both of these methods excited a great deal of interest among investigators, and soon numerous results of the experiments were published, which, however, were not uniformly favorable for either of the tests.

The best results were apparently obtained from the ophthalmic reaction. The changes in the eye resulting from a marked reaction are characteristic; intolerance to light and an increased secretion of tears are the first indications, which may be followed by more severe symptoms, as marked congestion of the conjunctiva, a whitish film-like exudate over the bulbar conjunctiva, and a grayish yellow discharge from the eye, which, running down the face, forms crusts. The test is applied to only one eye, and in the reaction the other or control eye should remain normal.

Thus far the ophthalmic and cuti tuberculin tests can not be recommended for general practice as methods of diagnosing tuberculosis of bovines, and they will require further work and perfection before they should pass from the experimental stage and be adopted in place of the present reliable subcutaneous application.

^b Reports of tuberculin tests made in the fifteen years from 1893 to 1908 by Federal, State, and other officers with tuberculin prepared by the Bureau of Animal Industry show that out of 24,784 reacting cattle slaughtered, lesions of tuberculosis were found in 24,387, a percentage of 98.39.

which show an elevation of temperature as a result of (a) advanced pregnancy; (b) the excitement of œstrum; (c) concurrent diseases, as inflammation of the lungs, intestines, uterus, udder, or other parts, abortion, retention of afterbirth, indigestion, etc.; (d) inclosure in a hot, stuffy stable, especially in summer, or exposure to cold drafts or rains; or (e) any change in the method of feeding, watering, or stabling of the animal during the test.

Notwithstanding all these possibilities of error, the results of thousands of tests show that in less than 3 per cent of the cases tested do these failures actually occur. In the first class the chances of error are decidedly reduced by the skilled veterinarian by making careful physical examination and diagnosing these advanced cases, and by the injection of double or triple doses into all recently tested cattle, with the taking of the after temperatures beginning two hours following the injection and continuing hourly for twenty hours. In the second class errors are avoided by eliminating those cases from the test that are nearing parturition or are in heat, or show evidence of the previously mentioned diseases, or exhibit temperatures sufficiently high to make them unreliable for use as normal. Then, in reading after temperatures it is advisable not to recognize as a reaction an elevation of temperature less than 2° F., or one which at the same time does not go above 103.8° F., and the temperature reaction must likewise have the characteristic rainbow curve. (Those cases which approximate but do not reach this standard should be considered as suspicious and held for a retest six weeks later.) In addition, a satisfactory tuberculin must be used, also an accurate thermometer and a reliable syringe in order that a sufficient dose of tuberculin may be given. Finally, the number of apparent errors of the tuberculin test will be greatly diminished if a careful post-mortem examination is made, giving especial attention to the lymph glands.

This low percentage of failures being the case, cattle owners should welcome the tuberculin test not only for their own interest but for the welfare of the public as well. Where this method of diagnosing the disease has been adopted tuberculosis is gradually being eradicated, while it is spreading rapidly and becoming widely disseminated in those districts where the tuberculin test has not been employed. Without its use the disease can not be controlled and the cattle owner is confronted with serious and continuous losses; with its use the disease can be eradicated from the herd, a clean herd established, and the danger of its spread to man removed. Tuberculin may, therefore, be considered a most beneficial discovery for the stock raiser. Strange to say, many of these men have been incredulous, antagonistic, or prejudiced against the tuberculin test by misinterpreting published

statements, by incorrect, unsubstantiated, or exaggerated reports, and by alleged injurious effects to healthy cattle.

Law ^a has clearly stated the question when he says:

Many stock owners still entertain an ignorant and unwarranted dread of the tuberculin test. It is true that when recklessly used by ignorant and careless people it may be made a root of evil, yet as employed by the intelligent and careful expert it is not only perfectly safe, but it is the only known means of ascertaining approximately the actual number affected in a given herd. In most infected herds, living under what are in other respects good hygienic conditions, two-thirds or three-fourths are not to be detected without its aid, so that in clearing a herd from tuberculosis, and placing both herd and products above suspicion, the test becomes essential.

* * * * *

In skilled hands the tuberculin test will show at least nine-tenths of all cases of tuberculosis when other methods of diagnosis will not detect one-tenth.

It is perfectly natural that there should be objection to its use among those who are not acquainted with its method of preparation or its properties; but it is difficult to explain the antagonism of farmers who are familiar with the facts connected with the manufacture and use of tuberculin. Probably the most popular objection to tuberculin is that it is too searching, since it discovers cases in which the lesions are small and obscure. While this fact is admitted, it should also be borne in mind that such a small lesion to-day may break down and become widely disseminated in a relatively short period. Therefore any cow affected with tuberculosis, even to a slight degree, must be considered as probably dangerous not only to the other animals in the herd but also to the consumer of her products.

THE HARMLESSNESS OF TUBERCULIN.

Furthermore, tuberculin must be considered as harmless for healthy animals in view of the results revealed by numerous tests covering vast numbers of animals. And it has also been clearly demonstrated that tuberculin interferes in no way with the milking function in healthy cattle; neither in the quantity of milk nor in butterfat value has any variation been detected.

Nocard and Leclainche ^b state:

Direct experiments and observations collected by thousands show that the tuberculin injections have no unfavorable effect. With healthy animals the system is indifferent to the inoculation; with tuberculous animals it causes only slight changes, which are not at all serious.

^a Text Book of Veterinary Medicine, vol. 4, pp. 458, 465. Ithaca, N. Y., 1902.

^b Les Maladies Microbiennes des Animaux, vol. 2, p. 85. Paris, 1903.

DISPOSAL OF AND INDEMNITY FOR REACTING ANIMALS.

Most of the objections to tuberculin would probably be removed if some method of compensation for the reacting animals could be devised. Thus, in Pennsylvania, where tuberculosis is being eradicated with more success than in any other State, and where there are usually three times as many voluntary requests on file for the application of the test as can be made, all reacting animals are paid for by the State. As the suppression of tuberculosis is a public health measure, it would appear perfectly logical for the State governments to reimburse cattle owners appropriately for the animals condemned and slaughtered. Provision could be made to pay 70 per cent of the appraised value of the condemned animals, not to exceed \$30 a head for common stock or \$60 for registered stock. Such legislation should also include a requirement for the testing of all dairy and breeding cattle coming into the State.

All tuberculous animals should be slaughtered in abattoirs having competent inspection, and the money obtained from those slight and localized cases which are inspected and passed for food and from the hide and offal of those carcasses condemned as unfit for food should be applied as part payment on the indemnity for their respective owners. The payment of indemnity for tuberculous animals is a good business policy and would do more toward making the tuberculin test popular with cattle owners than any other possible action. And as a corollary of the latter, more testing would be performed and more tuberculous cattle would be discovered at the start, but the gradual suppression of the disease would soon be manifest, as has been noted in Pennsylvania and Denmark. Furthermore, as Stiles has mentioned, if tuberculosis can be eradicated from dairy herds with but slight loss to the owner, the increase in the price of milk would naturally be inhibited, and the children of poor families would consequently be in less danger of having this very important article of their diet decreased.

CONCLUSIONS REGARDING THE TUBERCULIN TEST.

As a result of the careful study of the tuberculin test, Salmon^a draws the following conclusions:

1. That the tuberculin test is a wonderfully accurate method of determining whether an animal is affected with tuberculosis.
2. That by the use of tuberculin the animals diseased with tuberculosis may be detected and removed from the herd, thereby eradicating the disease.

^a Yearbook of the United States Department of Agriculture, 1901, p. 592.

3. That tuberculin has no injurious effect upon healthy cattle.

4. That the comparatively small number of cattle which have aborted, suffered in health, or fallen off in condition after the tuberculin test were either diseased before the test was made or were affected by some cause other than the tuberculin.

SUMMARY OF DIRECTIONS FOR MAKING THE TUBERCULIN TEST.

1. Stable cattle under usual conditions and among usual surroundings, feeding and watering in the customary manner.

2. Make a physical examination of each animal, and give to each one some designation by which the animal will be known throughout the test.

3. Take each animal's temperature at least three times at two or three hour intervals on the day of injection; for instance, at 2, 5, and 8 p. m.

4. At 8 or 10 p. m. inject a dose of tuberculin under the skin in the region of the shoulder, using a sterile hypodermic syringe after disinfecting the skin at the seat of injection with a 5 per cent solution of carbolic acid or a similar antiseptic solution.

5. Tuberculin is not always concentrated to the same degree, and therefore the dose, which should always appear on the label, varies considerably. The dose of imported tuberculin is 0.25 c. c. for an adult cow, and before injection is diluted with sterile water to 2 c. c. The tuberculin made by the Bureau of Animal Industry is prepared so that it will not be necessary to dilute it, and the dose is 2 c. c. for an adult animal. Yearlings and 2-year-olds, according to size, should receive from 1 to 1½ c. c., while bulls and very large animals may receive 3 c. c.

6. At 6 a. m. on the day following the injection of tuberculin commence taking temperatures, and continue every two or three hours until the twentieth hour after injection, at which time if there is no tendency for the temperature to rise the test may cease.

7. A rise of 2° F. or more above the maximum temperature observed on the previous day, providing the temperature after injection exceeds 103.8° F., should be regarded as an indication of tuberculosis. Those cases which approximate but do not reach this standard should be considered as suspicious and held for a retest six weeks later, giving double the original dose.

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